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Love Canal Emergency Declaration
Area Habitability Study. Volume 2
Air Assessment: Indicator Chemicals

CH2M Hill Southeast, Inc., Reston, VA

Prepared for

Environmental Protection Agency, New York

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Environmental Protection Agency

LOVE CANAL EMERGENCY DECLARATION AREA HABITABILITY STUDY

FINAL REPORT

VOLUME II

***Air Assessment--
Indicator Chemicals***

TECHNICAL REVIEW COMMITTEE

U.S. Environmental Protection Agency Region II

*U.S. Department of Health and Human Services /
Centers for Disease Control*

New York State Department of Health

New York State Department of Environmental Conservation

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VOLUME II

***Air Assessment--
Indicator Chemicals***

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LIST OF ACRONYMS AND ABBREVIATIONS

DHHS/CDC	U.S. Department of Health and Human Services/Centers for Disease Control
EDA	Love Canal Emergency Declaration Area
EMSL--RTP	U.S. EPA Environmental Monitoring Systems Laboratory at Research Triangle Park
EPA	U.S. Environmental Protection Agency
ERT	U.S. EPA Environmental Response Team
LCARA	Love Canal Area Revitalization Agency
LCIC	Love Canal Indicator Chemical
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORD	U.S. EPA Office of Research and Development
OTA	Congressional Office of Technology Assessment
ppb	Parts per billion
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
TAGA	Trace Atmospheric Gas Analyzer Model 6000E
TAT	Technical Assistance Team
TRC	Technical Review Committee

VOLUME II
AIR ASSESSMENT--INDICATOR CHEMICALS

FRRATA

<u>Page</u>	<u>Line</u>	<u>Erratum</u>
1-2	27	"in the basement samples collected, suggesting" should read "in the basement samples collected during the initial sampling and investigation, suggesting"
1-2	15-17	"during Phase 2 of the study, chlorotoluene was detected on the main floor of the unoccupied, single-story structure in Neighborhood 6. The highest concentration detected was 3.4 ppb" should read "during Phase 2 of the study chlorotoluene was detected in an unoccupied, single-story structure in Neighborhood 6. During the initial sampling and investigation chlorotoluene was only detected on the main floor of the home. Lower levels of chlorotoluene were detected both on the main floor and in the basement during the home's second sampling in Phase 2. The highest concentration detected was 3.4 ppb on the main floor during the home's initial sampling."
6-11	20	"Chlorotoluene was not detected in the basement." should read "Chlorotoluene was not detected in the basement during this initial sampling and investigation."
6-11	26	"Levels in all six of the first floor rooms were between the quantitation and" should read "levels in the main floor and the basement were between the quantitation and"
6-11	29	"This investigation did not detect chlorotoluene in the air in the basement of the home during either sampling effort" should be deleted.
6-11	26	"Levels in all six of the first floor rooms were between the quantitation and" should read "levels in the main floor and the basement were between the quantitation and"
6-11	29	"This investigation did not detect chlorotoluene in the air in the basement of the home during either sampling effort" should be deleted.

WDR355/060

1.0 SUMMARY

The Love Canal Emergency Declaration Area (EDA) Proposed Habitability Criteria (NYSDOH and DHHS/CDC, 1986) calls for three environmental studies. This report describes the air assessment for indicator chemicals while other reports describe the residential soil assessment for indicator chemicals and the residential soil assessment for dioxin.

The primary goal of the air assessment was to identify the presence of the Love Canal Indicator Chemicals (LCICs) for air in EDA residential structures. The LCICs used for the air assessment were chlorobenzene and chlorotoluene. A secondary goal of the study was to provide information that would be useful in planning for retesting and remediation of residences where appropriate.

The study was designed to detect low-level, about 1 part per billion (ppb), concentrations of air LCICs in residential structures and in ambient air in the EDA. Samples were taken in each room of the first floor and basement of each residence as well as from the ambient air outside the house both before and after indoor sampling. A protocol was developed to isolate the source of any detected LCIC within a residence. The sampling was performed over four 2-week periods from July to December 1987 to account for the effects of any temporal variations on LCIC concentration measurements. Sampling was conducted during all hours of the day and night to account for the effects of any diurnal variations on LCIC measurements. All residential structures that were structurally sound, physically accessible, and for which permission to enter could be obtained from the owner were entered and sampled.

The analytical method was selected based on the need for both real-time data and the capability to investigate for an emission source. A mobile mass spectrometer--mass spectrometer Trace Gas Atmospheric Analyzer (TAGA) was selected as the analytical instrument to fulfill these needs. Typical operation in the field consisted of instrument startup and tuning, initial quality assurance/quality control (QA/QC) checks and analyses, residence sampling and analyses, and final QA/QC

checks and analyses. Quality assurance measures included initial calibration, system checks, precision analyses, and performance evaluations. The data package for each residence sampled was formally validated by a separate group of scientists.

During sampling, only 44 of the 606 EDA homes were not sampled because of safety concerns related to the physical nature of the residence, unsafe structural conditions, lack of access, and/or nonparticipation by the owners. As a quality assurance measure, selected homes were sampled twice during a given phase. To account for the effects of temporal variations, selected homes were sampled during more than one of the study phases. Detection limits provided by the TAGA averaged 1.0 ppb for chlorotoluene and 0.8 ppb for chlorobenzene.

Chlorobenzene was not detected during the study. However, chlorotoluene was detected in one structure during the study. Twice during Phase 2 of the study, chlorotoluene was detected on the main floor of the unoccupied, single-story structure in Neighborhood 6. The highest concentration detected was 3.4 ppb.

If the Love Canal was the source of the chlorotoluene, the two most likely potential transport paths for this chemical would be either through the ambient air or by subsurface groundwater. LCICs were not detected in ambient air samples taken outside the home before and after sampling the home. This finding suggests that the LCIC concentration detected in the home was not influenced by transport above surface. Because LCICs are heavier than air, the highest concentrations of these compounds resulting from subsurface transport from the Canal would be expected in the basement. However, chlorotoluene was not detected in the basement samples collected, suggesting the LCIC detection was also not influenced by subsurface transport mechanisms.

Therefore, it is more likely that the source of chlorotoluene was located in the home on the main floor. The extensive investigation of the home, which included both a vertical and a perimeter sweep of each room, however, did not identify a specific source of chlorotoluene.

As specified in the proposed habitability criteria (NYSDOH and DHHS/CDC, 1986), retesting of the home was also performed in Phases 3 and 4. No LCICs were detected during the retesting. Chlorotoluene detection limits during the Phase 3 and 4 sampling of the home were 1.4

and 0.8 ppb, respectively. The house, primarily the garage, was being used by personnel working for LCARA. However, no products or materials used by these workers were identified as potential sources of chlorotoluene.

Chlorotoluene was detected once at less than the quantitation limit in the ambient air during Phase 4 of the study. The level detected was between the detection limit of 0.4 ppb and the quantitation limit of 1.3 ppb. Based on data collected at the Niagara Falls International Airport, winds were from the west at moderate speed (5 to 10 mph) throughout the day of the testing. These data suggest that a source of chlorotoluene may exist west of the EDA and that the source of the detected chlorotoluene was not the Love Canal.

In summary, of the 562 different homes sampled in the EDA, chlorotoluene was detected in only one home, and chlorobenzene was not detected in any home. There is no evidence to indicate that temporal, spatial, or other variables influence air LCIC concentrations in EDA homes. Because LCICs were detected in only one home, the importance of the effects of these variables on indoor air concentrations of LCICs could not be determined.

2.0 INTRODUCTION

This report is Volume II of a five-volume series. Volume I provides an introduction and documentation of the decision-making during the development of the Love Canal Emergency Declaration Area (EDA) Habitability Study. Volume III presents the results of the residential soil assessment for indicator chemicals. Volume IV reports on the residential soil assessment for 2,3,7,8-TCDD (dioxin), and Volume V summarizes the subsequent peer review of Volumes II, III, and IV and the responses to that peer review.

This document summarizes the design and results of the air assessment for indicator chemicals. It is presented in six main sections and contains three appendices. Sections 3.0, 4.0, and 5.0, respectively, discuss the study goals, design, and analytical method. Section 6.0 summarizes the study sampling results. The appendices summarize the quality assurance/quality control (QA/QC) and data validation efforts maintained throughout the study.

2.1 BACKGROUND

A detailed background of the history of Love Canal is presented in Volume I of the study. However, this section provides a brief summary to assist the reader in understanding the overall intent of the Love Canal EDA Habitability Study and the role of the air assessment.

The former Love Canal landfill was a rectangular, 16-acre tract of land located in the southeast end of the City of Niagara Falls in Niagara County on the western edge of New York State. The landfill takes its name from William T. Love, whose plan in the 1890s was to dig a power canal between the upper and lower Niagara River to provide inexpensive hydroelectric power for a proposed model industrial city. The model city project and the partially dug Canal were abandoned before the turn of the century. The abandoned Canal was used as a chemical waste dump from 1942 to 1953. In 1953, the site was closed. Subsequently, a number

of homes have been built around the Canal, and the 99th Street School was built adjacent to the Canal.

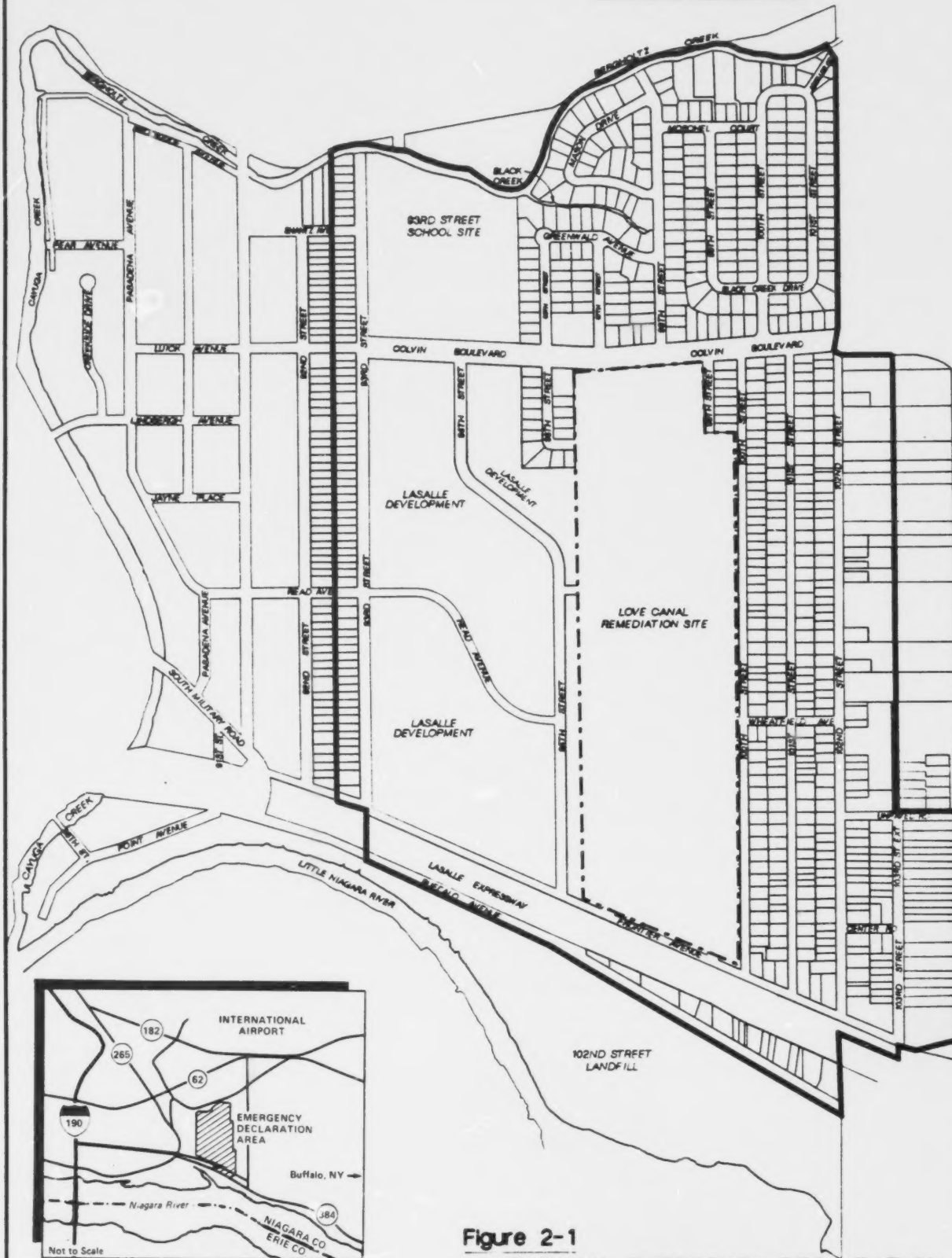
In the spring of 1978, following a series of complaints by local residents, a number of studies were initiated to investigate the health and environmental problems at the Love Canal. Under the direction of the New York State Department of Health (NYSDOH), basement sump pits were sampled and analyzed, and, under the direction of the U.S. Environmental Protection Agency (EPA), air samples were taken at homes abutting the Canal. These results revealed significant contamination, and in August 1978, a state of emergency was declared by President Carter. Homes were evacuated and remedial efforts were under way by October 1978.

Remediation at Love Canal has been extensive. Initial remediation concentrated on site containment. A clay cap was installed over the Canal area, and perimeter drains were installed during the period from May to November 1979. A leachate collection system and a leachate treatment plant were constructed during late 1979.

In May 1980, President Carter issued a second emergency declaration for Love Canal establishing the Emergency Declaration Area (EDA) as shown in Figure 2-1, and more homes were evacuated. Eligible properties were purchased from evacuating residents by the Love Canal Area Revitalization Agency (LCARA).

In the summer of 1982, the EPA released a report of an assessment of the extent of contamination of air, water, and soil in the EDA for use as a basis in forming recommendations regarding future use of the area (U.S. EPA, 1982). Later, the Department of Health and Human Services (DHHS) reviewed the EPA study and other data to determine whether the EDA were habitable. In July 1982, after considering comments by the National Bureau of Standards on the procedures the EPA used and after further consultation with the EPA, DHHS affirmed an earlier provisional decision that the EDA was as habitable as the control areas to which it was compared. This decision was contingent on the provision that the storm sewers and their drainage tracts be cleaned and that special plans be made to perpetually safeguard against future leakage from the Canal.

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VICINITY MAP

Figure 2-1

LOVE CANAL EMERGENCY DECLARATION AREA

NIAGARA FALLS, NEW YORK

SCALE: 1"=750'

LEGEND

— EMERGENCY DECLARATION AREA (EDA) BOUNDARY

SOURCE:
EDA BOUNDARIES TAKEN FROM NEW YORK STATE
REAL PROPERTY TAX LAW ARTICLE 17 SECTION 1702.

In December 1982, the Congressional Office of Technology Assessment (OTA) was requested to examine the technical basis for and validity of the habitability decision for the EDA. In June 1983, the OTA reported that, with the information available, it was not possible to conclude whether or not unsafe levels of toxic contamination existed in the EDA and that the analysis of available data did not support the DHHS decision that the EDA was as habitable as the control areas with which it had been compared (OTA, 1983).

In August 1983, in response to the OTA report, the EPA established a Technical Review Committee (TRC) composed of representatives from the EPA, NYSDOH, DHHS/Centers for Disease Control (DHHS/CDC), and New York State Department of Environmental Conservation (NYSDEC) to coordinate and oversee the habitability and remedial programs at Love Canal. The member agencies of the TRC asked NYSDOH and DHHS/CDC to develop criteria that would be considered by the New York State Commissioner of Health in his determination of whether or not the EDA were habitable. In 1986, the "Love Canal Emergency Declaration Area Proposed Habitability Criteria" (NYSDOH and DHHS/CDC, 1986) was issued. The habitability criteria document underwent peer review (Life Systems, 1986) and reflects the concerns of the peer review panel. The habitability criteria related to this study are discussed in Section 2.2.

In May 1985, a Superfund Record of Decision (ROD) was put forth describing the selected remedial alternative for contaminated drainage tracts. The alternative included cleaning storm and sanitary sewers, removal and storage of creek sediments, and construction of a permanent administration building. In October 1987, a second ROD was put forth selecting onsite thermal destruction as the treatment technique for the creek and sewer sediments.

Since the remediation efforts were initiated, the storm and sanitary sewers that served the Love Canal have been taken out of service, plugged, and cleaned. More recent efforts implementing the RODs included the following: (1) continued remediation of area sewers, (2) construction of a remedial program administration building, (3) design of the creek excavation program, (4) design of an above-ground interim containment facility for the storage of sediments to be removed from the creeks and also for the storage of hazardous wastes generated by some of the site's other remedial programs, and

(5) design and installation of a long-term perimeter groundwater monitoring system.

2.2 HABITABILITY CRITERIA

The habitability criteria stipulate that for chemicals identified in environmental media to which residents and potential residents may have significant exposure, relevant Federal or New York State standards, criteria, and guidelines will be used to assess the habitability of the EDA. The only known applicable guideline is the CDC level of concern of 1.0 part per billion (ppb) for 2,3,7,8-TCDD (dioxin) in residential soil.

Where relevant standards, criteria, or guidelines are not available, a comparison methodology will be used to assess the relative habitability of the EDA. To determine the relative habitability of the EDA, the habitability criteria calls for a comparison of the results of environmental sampling for Love Canal Indicator Chemicals (LCICs) in neighborhoods (soil) and residences (air) in the EDA with the results of sampling for LCICs in similar inhabited communities.

The proposed habitability criteria require that the air in each residence in the EDA be sampled for airborne LCICs, chlorobenzene, 2-chlorotoluene, and 4-chlorotoluene. The LCICs are intended to represent chemicals whose presence in indoor air would strongly suggest that they originate from the Love Canal. Standards, criteria, and guidelines were not available for the compounds selected for this air assessment. The concentrations of these chemicals in occupied EDA residences were to be compared to concentrations of the LCICs in the comparison area homes according to the proposed habitability criteria. Any occupied EDA residences that were found to have LCIC concentrations significantly greater than the chosen aggregate concentration of the LCICs in the comparison areas would be retested and, if appropriate, would be remediated later. The concentrations of LCICs in unoccupied EDA residences were to be compared to EDA ambient air LCIC concentrations. Unoccupied EDA residences with air LCIC concentrations significantly greater than the chosen aggregate LCIC concentration of the EDA ambient air would also be retested and, if appropriate, would be remediated later. (The results of an air pilot

study led to the elimination of sampling in comparison areas as discussed in Section 2.3.)

In addition, as indicated in the proposed habitability criteria document, EDA neighborhoods may be deemed uninhabitable if individual homes within it are deemed uninhabitable.

2.3 PILOT STUDY

In preparation for the air assessment, a pilot study was conducted during July 1986 to demonstrate the feasibility of implementing the habitability criteria as proposed. Specific objectives were to:

- Test the sampling and analytical methods proposed for the habitability study.
- Provide preliminary data on the levels and statistical distribution of indicator contaminant concentrations.
- Provide a basis for determining the number of samples that need to be taken to produce statistically valid results in the habitability study.

Samples were collected to determine the levels of LCICs in the air at selected EDA and comparison area residences (CH2M HILL, 1987a). Air samples were collected in stainless steel canisters and were analyzed in the field using a mobile mass spectrometer--mass spectrometer Trace Atmospheric Gas Analyzer (TAGA). All samples identified by the TAGA as containing indicator chemicals, as well as samples used for quality assurance purposes, were sent to the laboratory for further analysis and verification.

The results indicated detectable concentrations of air LCICs in only one of the 63 residences investigated in the EDA and in only one of the 31 residences investigated in the comparison areas. Low levels of chlorotoluene were detected in both samples.

Based on the results of the pilot study, the expected concentration (95th percentile) of an air LCIC in both the EDA ambient air and the

comparison areas is a nondetect. Because of this, a decision was made to simplify the habitability study design by sampling only in the EDA. "Because of the small number of detects involved, it is simpler and more efficient to resample any house in which an LCIC is detected and attempt to identify the source of the LCIC rather than to sample comparison areas" (CH2M HILL, 1987a).

The other conclusions and recommendations of the pilot study that were enacted by the TRC are:

- The Trace Atmospheric Gas Analyzer is the appropriate analytical instrument to use for the habitability study.
- Samples should be collected by means of a long transport tube connected directly to the TAGA.
- 2- and 4-chlorotoluene would be measured as total chlorotoluene because the TAGA is incapable of distinguishing between different chlorotoluene isomers.
- The potential temporal variability of LCIC values should be accounted for in the design of the habitability study.

2.4 STUDY DESIGN PEER REVIEW

A scientific peer review of the EDA habitability study design was conducted in March 1987 (Life Systems, 1987). For the air assessment, concern was expressed about the identification of critical variables that could influence the presence or release of LCICs in homes. The sampling plan should be developed to have the "...maximum likelihood of detecting LCICs that may be present" (Life Systems, 1987). The peer review panel agreed with the recommendations of the pilot study and further recommended that the sampling study design consider the following variables:

- Seasonal variations
- Diurnal variations
- Rainfall and groundwater levels
- Location relative to the Canal
- Occupied versus unoccupied status

The rationale for selection of these variables is contained in the peer review summary (Life Systems, 1987).

Section 4.0, Design, describes how these variables are incorporated in the air assessment design.

3.0 GOALS

The air assessment was designed to provide data to assist the New York State Commissioner of Health in determining the habitability of structures within the Emergency Declaration Area (EDA). As discussed in Section 2.0, the small number of detects observed in the pilot study enables air Love Canal Indicator Chemical (LCIC) comparisons to be accomplished by sampling only residences in the EDA. In effect, then, any air LCIC concentration detected in an EDA residence would be compared to an aggregate concentration in the comparison areas assumed to be nondetect.

Therefore, the major goal of the air assessment was to identify, to the maximum extent practically feasible, all EDA residences where detectable concentrations of air LCICs exist. It was not the objective of the air assessment to characterize the level of air LCICs in the EDA residences. As described in Section 4.0, the air assessment was designed to sample all EDA residences in a random manner respecting spatial, temporal, and other variables postulated to affect the presence of air LCICs. This was intended to increase the chances that any detectable air LCIC concentrations present would be discovered and measured.

The habitability criteria document (NYSDOH and DHHS/CDC, 1986) also directed that residences having air LCIC concentrations significantly greater than the comparison levels (i.e., nondetect) be retested and remediated if appropriate. Thus, an implied operational objective of the air assessment design was to provide sufficient information to plan retesting and remediation efforts where appropriate. The air assessment sampling program described in Section 4.0 was designed to yield information on the variables postulated to affect the distribution of air LCIC concentrations. However, the design can provide this information only if a sufficient number of air LCIC detects are observed to allow statistical analysis of patterns among these variables. The assessment design also directs the sampling team to attempt to isolate any indoor location of a detected air LCIC and the emission source.

Sections 4.0 and 5.0, respectively, describe the study design and method by which these study goals were attained.

4.0 DESIGN

The design of the air assessment was directed by the Technical Review Committee (TRC) based on the proposed habitability criteria (NYSDOH and DHHS/CDC, 1986), the results of the air pilot study (CH2M HILL, 1987a), and the peer review of the pilot study (Life Systems, 1987). Generally, the design of a sampling study involves three main elements: project organization, field sampling design, and data quality assurance (QA). Each of these three elements are discussed below.

4.1 PROJECT ORGANIZATION

Project organization and the responsibilities of key personnel are detailed in this assessment's Quality Assurance Project Plan (QAPP) (CH2M HILL, 1987b, Chapter 3). This assessment was directed by U.S. Environmental Protection Agency (EPA) Region II. The assessment was conducted by U.S. EPA's Environmental Response Team (ERT) (and its contractors Enviroresponse, Inc., and Weston/REAC) and CH2M HILL, Inc. (and its subcontractor Horizon Systems Corporation). Sampling schedule assistance was provided by the New York State Department of Health (NYSDOH). Quality assurance/quality control (QA/QC) was provided by U.S. EPA's Environmental Monitoring Systems Laboratory at Research Triangle Park (EMSL--RTP), and data validation was provided by ERT's Technical Assistance Team (TAT) contractor.

4.2 FIELD SAMPLING DESIGN

The field sampling program was designed to meet both the study goals as discussed in Section 3.0 and the specific objectives that were established by the TRC as discussed in Sections 2.3 and 2.4. In accordance with the proposed habitability criteria, air sampling inside each EDA residence was scheduled. When requested, sampling of nonresidential properties (i.e., churches, commercial establishments, etc.) was also scheduled. Sampling

was scheduled over different seasonal and diurnal time periods so that variables associated with these different time periods and thought to potentially influence the levels of Love Canal indicator chemicals (LCICs) in indoor air would then be accounted for.

All residential structures within the Emergency Declaration Area (EDA) were sampled except for a limited number of homes that could not be reached by the sampling probe, homes for which permission to gain entry was not granted, and homes that could not be entered due to safety concerns related to the physical nature of the residence (e.g., collapsed ceiling). Residential structures containing one or more dwelling units (i.e., single- or multiple-family structures) are located within the EDA. Multiple-family structures are located only in the LaSalle housing development (see Figure 2-1). All single-family structures as well as all occupied units located in multiple-family structures were scheduled for sampling.

Unoccupied dwelling units in the multiple-family structures were selected for sampling based on the following criteria:

- If the structure contained fewer than five dwelling units, one unoccupied unit was sampled.
- If the structure contained five or more dwelling units, two unoccupied units were sampled.

These selection criteria were adopted by the TRC to provide adequate representation of the LaSalle housing development without sampling every unit.

In addition to residential structures, most churches and commercial establishments in the EDA were also sampled. Sampling was performed at nonresidential properties only when requested by the establishment owner. Throughout this report, the terms "residence" and "home" are used and represent all structures sampled, including churches and commercial establishments.

Sampling of EDA residences was designed to provide data on the presence of LCICs and to yield information on the variables that may influence indoor LCIC concentrations. To observe the effects of

seasonal variables, sampling was performed over four 2-week time periods (phases) during the months of July through December. Approximately equal numbers of residences were randomly allocated to each of the four sampling phases. These randomly selected residences were well distributed throughout the EDA for each sampling phase. This distribution enabled the evaluation of the presence of detectable levels of LCICs in homes located at various distances and directions away from the Canal.

Residences selected for sampling in a given phase were grouped spatially to make sampling more efficient. These groups were then randomly assigned to a specific sampling day.

Daily sampling was performed in shifts averaging approximately 12 hours. The starting times of these shifts were varied so that sampling of unoccupied homes was performed throughout all hours of the day and night during a given phase to allow observation of any detectable diurnal variation of LCICs. Sampling of occupied homes was conducted only between the hours of 7:00 a.m. and 9:00 p.m.

Permission to sample occupied homes was obtained through correspondence and personal communication with the homeowners. This permission along with the scheduling and, if necessary, rescheduling of sampling times was coordinated through the NYSDOH. When possible, homeowners unable to have their homes sampled during the scheduled time were rescheduled during that same sampling phase. Those homeowners declining to participate in the study during its first three phases were notified prior to the beginning of Phase 4 and were given an additional opportunity to participate.

At every residence sampled, indoor air within each room in the basement (if a basement existed) and on the first floor was sampled and analyzed. Ambient air samples were taken at approximately midway between the street and the front of the home and were analyzed both before and after indoor sampling of each structure to evaluate influences of outdoor LCIC concentrations on indoor sampling results. With the exception of residences resampled for QA purposes, individual residences were sampled only once. The average total sampling time for each residence was approximately 45 minutes.

In the event that an LCIC was detected inside the residence, a detailed investigation for a source of the LCIC was conducted. This investigation included both a vertical and horizontal sweep of the air in each room of the home's first floor and basement in an effort to better characterize the location of the LCIC and to identify the emission source.

A detailed description of the field sampling program is found in the study's QAPP (CH2M HILL, 1987b, Chapter 5).

4.3 DATA QUALITY ASSURANCE

The overall QA objective of the air assessment was to collect samples and to provide analytical data of known, defensible quality. Data quality objectives were established stipulating that data collection and analysis methods had to meet specific accuracy and precision requirements (CH2M HILL, 1987b).

Both internal and external performance audits were conducted in order to demonstrate that these data quality objectives were met. Routine QA procedures, including internal performance audits and instrument calibrations, are discussed in detail in the study's QAPP (CH2M HILL, 1987b). External performance audits were conducted during each sampling phase by the Quality Assurance Division of EPA EMSL--RTP. A summary of results for both the internal and external audits are found in Appendices A and B.

Additional QA was provided to the project through both replicate and overlap sampling. Replicate sampling involved sampling selected residences twice in the same phase. Overlap sampling included those residences sampled in more than one phase and involved the selection of three residences sampled once in each of the four phases.

Detailed discussion of the QA procedures is found in the study's QAPP (CH2M HILL, 1987b, Chapter 4 and Appendix A).

5.0 METHOD

Selection of a method to collect and analyze indoor air samples was based primarily on the need for real-time data and the capability to investigate for an emission source as soon as a Love Canal Indicator Chemical (LCIC) was detected. As recommended in the pilot study (CH2M HILL, 1987a) as well as by peer reviewers (Life Systems, 1987), the Technical Review Committee (TRC) chose to use the Trace Atmospheric Gas Analyzer (TAGA) Model 6000E with a sampling hose to collect the indoor air within the residences.

5.1 SAMPLE COLLECTION AND ANALYSIS

The TAGA used in this study is part of the Environmental Protection Agency's (EPA) Mobile Air Monitoring Laboratory. It is capable of acquiring real-time concentrations of chlorobenzene and chlorotoluene at low parts per billion (ppb) levels. Typical operation of the TAGA in the field consisted of instrument startup and tuning, initial quality assurance/quality control (QA/QC) checks and analyses, residence sampling and analyses, and final QA/QC checks and analyses. TAGA operation and data reporting procedures are discussed in detail in the study's Quality Assurance Project Plan (QAPP) (CH2M HILL, 1987b, Appendix A).

Sample collection at each residence was preceded by an investigation by the site safety officer of the home's structural integrity and its accessibility by the sampling team.

Sample collection at the residence consisted of an instrument calibration, a survey of the outside ambient air, and surveys of all the rooms on the first floor and in the basement of the residence. Each room survey consisted of sampling air from the center of the room at normal breathing height (approximately 5 feet above the floor) for approximately one minute. If an LCIC was detected, the room survey data were reviewed to determine the room (or rooms) most likely to

contain the emission source(s). These rooms were sampled in detail in an attempt to isolate the emission source.

After sampling of the residence was completed, an additional survey of the ambient air was taken. The sample collection procedures are detailed in the study's QAPP (CH2M HILL, 1987b, Chapter 5 and Appendix A).

5.2 DOCUMENTATION

In preparation for sample analysis, instrument startup, initial calibration, and system checks were performed and documented. Precision analyses and performance evaluations were also documented.

Each activity relating to sample collection and sample analysis was documented on specific forms. Data packages were assembled for each house sampled and were reviewed for completeness and data validity by a field review team. The contents of the data package and the forms used are described in the study's QAPP (CH2M HILL, 1987b, Chapter 9 and Appendix A).

5.3 DATA VALIDATION

Formal validation of the data package for each residence sampled was performed by the data validation team assembled from U.S. EPA Environmental Response Team's (ERT) Technical Assistance Team (TAT). The data validation team was kept independent of sample collection and analysis activities in order to provide an objective review of the data packages. Validation of the data included checking the data package for completeness and consistency between sample collection and analysis, evaluating instrument performance, and validating the analytical data. Data validation review criteria are summarized in Appendix C and are discussed in detail in the study's QAPP (CH2M HILL, 1987b, Appendix A).

6.0 RESULTS

Results of the air assessment are reported below in terms of sampling activity and analytical results. Sampling activity is summarized over seasonal and diurnal time periods in Section 6.1. Section 6.2 discusses the results of quality assurance (QA) activities. Detection of Love Canal Indicator Chemicals (LCICs) during the sampling is discussed in Section 6.3.

6.1 SAMPLING ACTIVITY

The air assessment was completed in four phases during the months of July through December, 1987. The sampling periods for the four phases were as follows:

- Phase 1--July 28 through August 11
- Phase 2--September 15 through September 27
- Phase 3--October 27 through November 6
- Phase 4--December 1 through December 13

Table 6-1 summarizes the sampling activity during each of the four study phases. Eighty-one (75 percent) of the 108 Emergency Declaration Area (EDA) homeowners agreed to participate in this study. Only 9 (1.5 percent) of the 606 different EDA homes could not be entered because of safety concerns related to the physical nature of the residence. Eight homes (1.5 percent) were not accessible to the sampling team either because of locked entries for which keys could not be obtained or because the homes could not be reached by the sampling hose.

Of the 606 different homes existing in the EDA, 93 percent, or 562 different homes, were sampled during the study. Of this total, 119 were multiple-family dwelling units and 9 were churches or commercial establishments. As part of the study's quality assurance criteria, selected

Table 6-1

Sampling Activity Summary By Phase

	Sampling Phases					Total All Phases
	Phase 1	Phase 2	Phase 3	Phase 4		
	Jul 28 – Aug 11	Sept 15 – Sept 27	Oct 27 – Nov 6	Dec 1 – Dec 13		
Homes Sampled						
Occupied	22	15	21	23	81	
Unoccupied	122	116	118	125	481	
Number of different homes	144	131	139	148	562	
QA replicates ^a	2	3	3	3	11	
QA overlaps ^b	0	3	6	4	13	
Total Homes Sampled	146	137	148	155	586	
Homes Scheduled but Not Sampled						
Homeowner did not participate in study	7	6	5	9	27	
Not physically accessible	0	1	0	7	8	
Considered unsafe to enter	0	3	3	3	9	
Total Homes Not Sampled	7	10	8	19	44	
Total Different EDA Homes	151	141	147	167	606	

^aHomes sampled twice during a given phase^bHomes sampled in more than one phase

Note: The term "homes" includes residential and nonresidential properties.

homes were sampled twice during a given phase (replicate samples). In addition, other selected homes were sampled once during more than one of the four study phases (overlap samples). Including replicate and overlap samples, the total number of times homes were sampled was 586. Figures 6-1 through 6-4 show the locations of the structures sampled during each of the four study phases.

Neighborhood boundaries as designated in the proposed habitability criteria (NYSDOH and DHHS/CDC, 1986) are also shown in each figure. Table 6-2 summarizes the sampling activity within each of the 13 EDA neighborhoods. Table 6-3 summarizes the number of occupied and unoccupied homes sampled per phase in each hour of the day. This table represents the seasonal and diurnal distribution of homes sampled. Table 6-4 presents the number of occupied and unoccupied homes sampled by sampling phase and neighborhood.

6.2 QUALITY ASSURANCE RESULTS

Completion of the air assessment resulted in analytical data of known, defensible quality, meeting both the data quality objectives and overall goals of the study. Extensive QA and data validation significantly contributed to the data's defensibility. Further discussion on how specific data quality objectives were met is found in Appendix A. A discussion of the results of the external auditing performed on the study's procedures and analytical data is found in Appendix B. Results of the data validation effort are summarized in Appendix C.

6.3 ANALYTICAL RESULTS

As detailed in the study's Quality Assurance Project Plan (QAPP) (CH2M HILL, 1987b, Appendix A), there were limits to the analytical instrument's ability to identify and quantify compounds at the time when a residence was sampled. These limits are referred to as the detection and quantitation limits. Compounds measured at concentrations between the detection and quantitation limits are considered to be identified but not quantifiable and are referred to as trace levels.



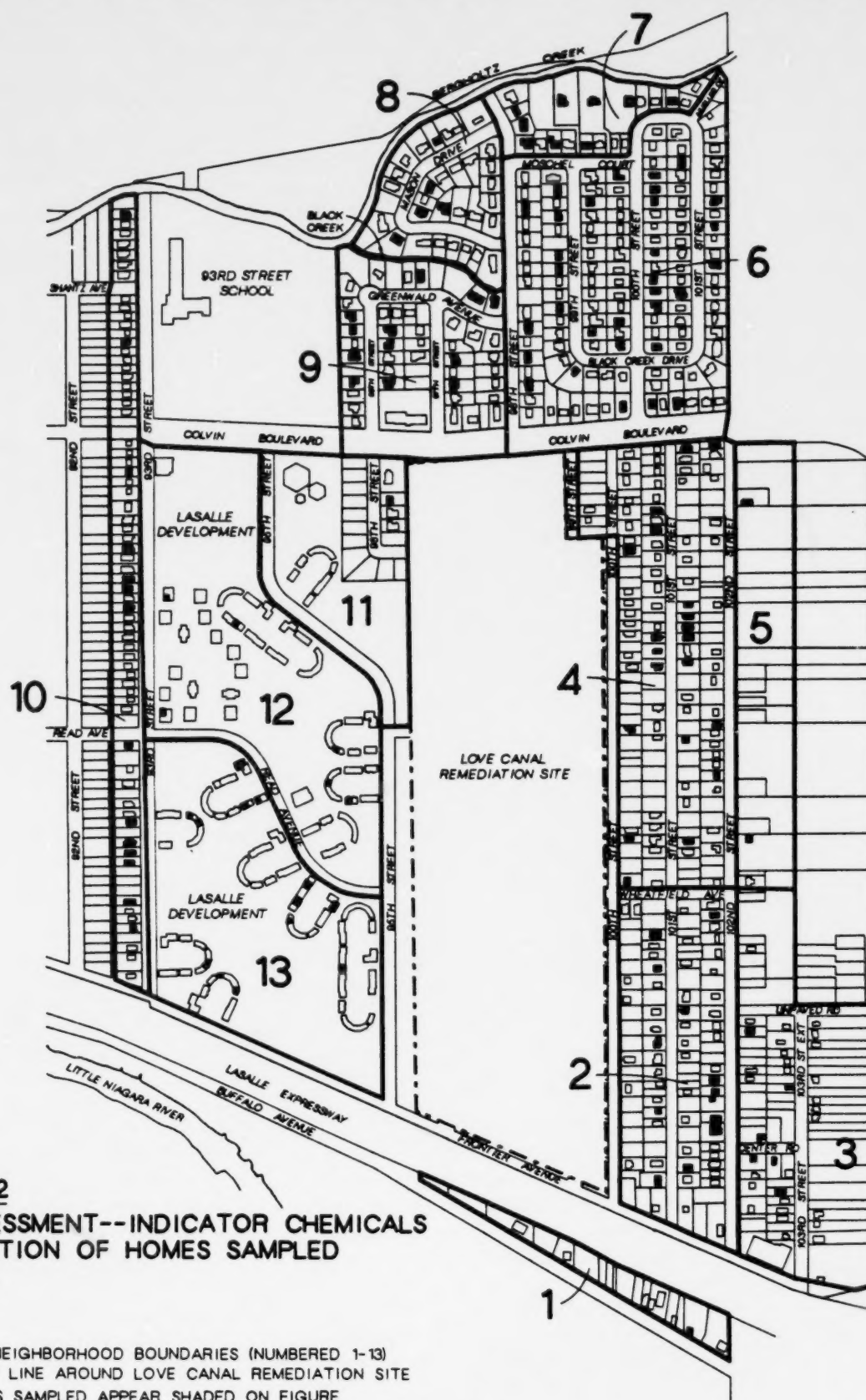


Figure 6-2

**AIR ASSESSMENT--INDICATOR CHEMICALS
DISTRIBUTION OF HOMES SAMPLED
PHASE 2**

SCALE: 1"=650'

LEGEND

- EDA NEIGHBORHOOD BOUNDARIES (NUMBERED 1-13)
- - - FENCE LINE AROUND LOVE CANAL REMEDIATION SITE
- HOMES SAMPLED APPEAR SHADED ON FIGURE

SOURCE: NEIGHBORHOOD BOUNDARIES ADAPTED FROM THE PROPOSED HABITABILITY CRITERIA DOCUMENT (INYSDOH AND DHHS/CDC, 1986).

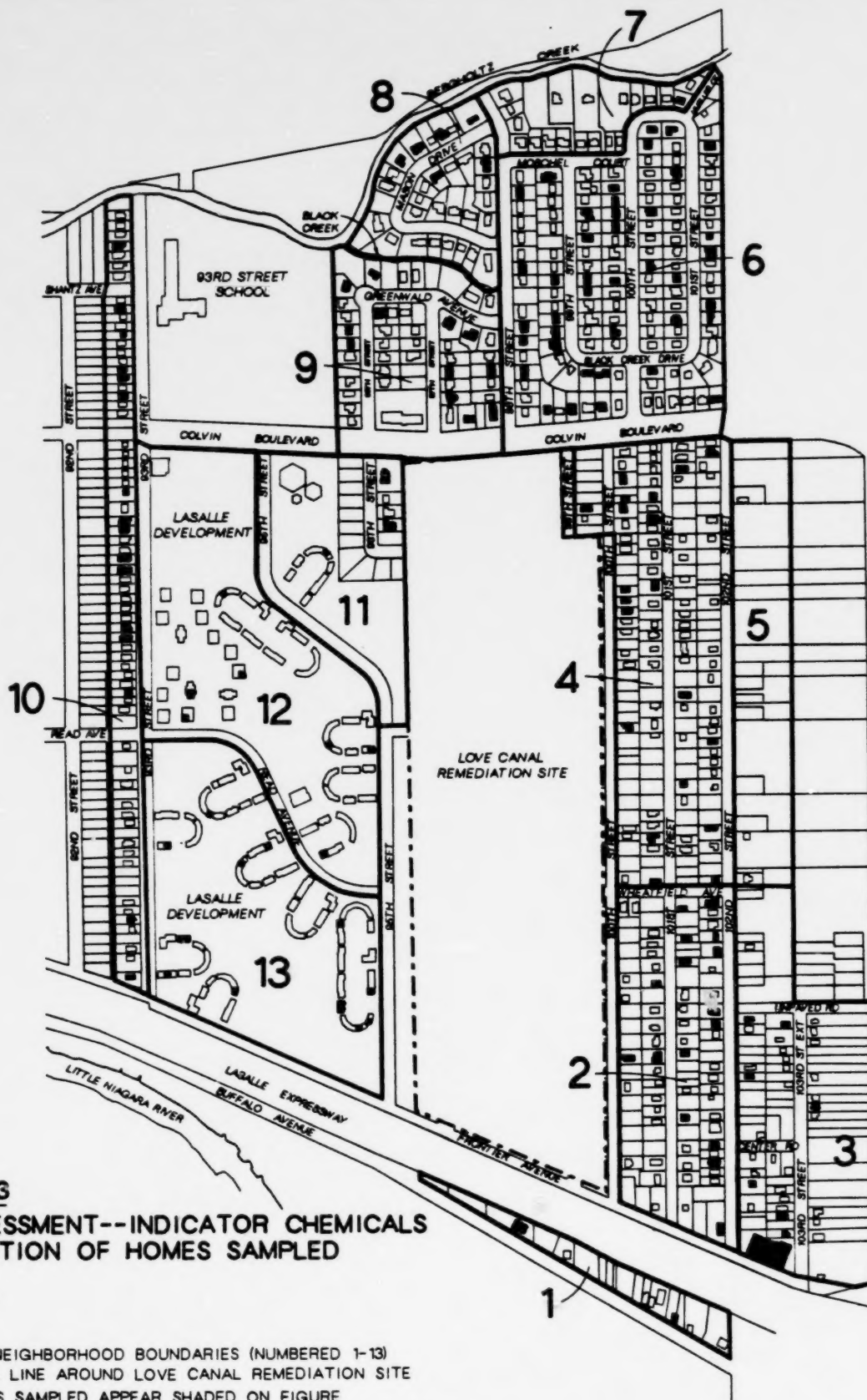


Figure 6-3

**AIR ASSESSMENT--INDICATOR CHEMICALS
DISTRIBUTION OF HOMES SAMPLED
PHASE 3**

SCALE: 1"=650'

LEGEND

- EDA NEIGHBORHOOD BOUNDARIES (NUMBERED 1-13)
- - - FENCE LINE AROUND LOVE CANAL REMEDIATION SITE
- HOMES SAMPLED APPEAR SHADED ON FIGURE

SOURCE: NEIGHBORHOOD BOUNDARIES ADAPTED FROM THE PROPOSED
HABITABILITY CRITERIA DOCUMENT (NYSDOH AND DHHS/CDC, 1986).

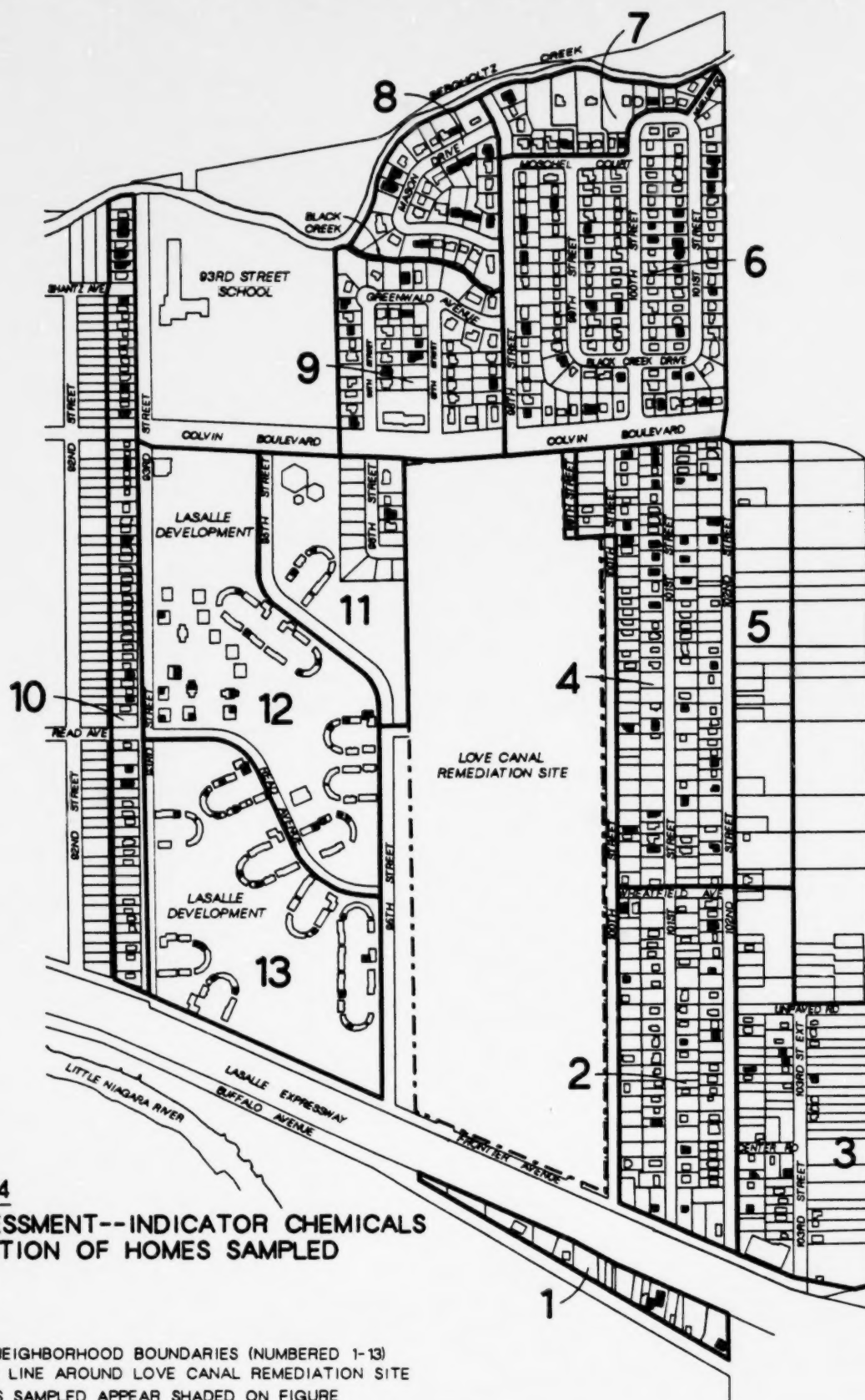


Figure 6-4

**AIR ASSESSMENT--INDICATOR CHEMICALS
DISTRIBUTION OF HOMES SAMPLED
PHASE 4**

SCALE: 1"=650'

LEGEND

- EDA NEIGHBORHOOD BOUNDARIES (NUMBERED 1-13)
- - - FENCE LINE AROUND LOVE CANAL REMEDIATION SITE
- HOMES SAMPLED APPEAR SHADED ON FIGURE

SOURCE: NEIGHBORHOOD BOUNDARIES ADAPTED FROM THE PROPOSED HABITABILITY CRITERIA DOCUMENT (NYSDOH AND DHHS/CDC, 1986).

Table 6-2
Sampling Activity Summary By EDA Neighborhoods - All Phases^a

Neighborhoods	Homes Scheduled But Not Sampled			Homes Sampled		Total Homes in EDA
	Homeowner Did Not Participate	Not Accessible	Considered Unsafe	Total	Number of Different EDA Homes Sampled	
1	1	0	0	1	7	8
2	5	2	1	8	52	60
3	5	0	1	6	29	35
4	4	0	4	8	79	87
5	0	0	0	0	3	3
6	2	0	1	3	128	131
7	0	0	0	0	19	19
8	1	0	0	1	29	30
9	4	1	0	5	37	42
10	5	1	2	8	56	64
11	0	0	0	0	11	11
12	0	4	0	4	48	52
13	0	0	0	0	64	64
Total	27	8	9	44	562	606

^aIn accordance with the study design, all single-family homes for which permission to sample was given were sampled, but not all multiple-family homes were. In each multiple-family structure, all occupied homes and one or two unoccupied homes were scheduled for sampling. If the multiple-family structure contained fewer than five dwelling units, one unoccupied unit was sampled. For structures with five or more dwelling units, two unoccupied units were sampled. The term "homes" includes residential and nonresidential properties.

Table 6-3

Sampling Summary By Sample Start Hour, Phase, And Occupied/Unoccupied Status

Sample Start Hour ^c	Sampling Phases												Total All Phases Homes Sampled		
	Phase 1 JUL 28-AUG 11 Homes Sampled ^{a,b}			Phase 2 SEPT 15-SEPT 27 Homes Sampled			Phase 3 OCT 27-NOV 06 Homes Sampled			Phase 4 DEC 01-DEC 13 Homes Sampled					
	Occ. ^d	Unocc. ^e	Total	Occ.	Unocc.	Total	Occ.	Unocc.	Total	Occ.	Unocc.	Total	Occ.	Unocc.	Total
Midnight - 1 am	0	2	2	0	4	4	0	2	2	0	2	2	0	10	10
1 am - 2 am	0	4	4	0	4	4	0	4	4	0	3	3	0	15	15
2 am - 3 am	0	3	3	0	4	4	0	5	5	0	5	5	0	17	17
3 am - 4 am	0	5	5	0	6	6	0	5	5	0	4	4	0	20	20
4 am - 5 am	0	4	4	0	4	4	0	6	6	0	3	3	0	17	17
5 am - 6 am	0	5	5	0	1	1	0	5	5	0	4	4	0	15	15
6 am - 7 am	0	6	6	0	4	4	0	7	7	0	5	5	0	22	22
7 am - 8 am	0	5	5	0	7	7	0	9	9	1	9	10	1	30	31
8 am - 9 am	0	4	4	2	7	9	1	10	11	2	7	9	5	28	33
9 am - 10 am	2	5	7	3	3	6	4	4	8	1	6	7	10	18	28
10 am - 11 am	1	11	12	2	5	7	3	5	8	2	7	9	8	28	36
11 am - Noon	3	7	10	0	6	6	1	5	6	6	5	11	10	23	33
Noon - 1 pm	1	4	5	0	6	6	1	5	6	2	6	8	4	21	25
1 pm - 2 pm	2	5	7	2	6	8	4	3	7	0	9	9	8	23	31
2 pm - 3 pm	2	3	5	0	12	12	2	6	8	4	6	10	8	27	35
3 pm - 4 pm	3	6	9	1	10	11	2	7	9	2	5	7	8	28	36
4 pm - 5 pm	3	5	8	3	7	10	1	9	10	2	10	12	9	31	40
5 pm - 6 pm	2	7	9	1	6	7	1	5	6	1	11	12	5	29	34
6 pm - 7 pm	1	10	11	0	3	3	1	4	5	0	5	5	2	22	24
7 pm - 8 pm	2	7	9	0	4	4	0	4	4	0	4	4	2	19	21
8 pm - 9 pm	0	7	7	1	4	5	0	3	3	0	4	4	1	18	19
9 pm - 10 pm	0	2	2	0	4	4	0	6	6	0	5	5	0	17	17
10 pm - 11 pm	0	3	3	0	3	3	0	3	3	0	4	4	0	13	13
11 pm - Midnight	0	4	4	0	2	2	0	5	5	0	3	3	0	14	14
Total Homes	22	124	146	15	122	137	21	127	148	23	132	155	81	505	586

^aThe term "homes" includes residential and nonresidential properties.^bHomes sampled include QA replicates and overlaps.^cStart time is expressed as local time.^dOcc. indicates occupied home.^eUnocc. indicates unoccupied home.

Table 6-4
Sampling Summary By EDA Neighborhoods, Phase, And Occupied/Unoccupied Status

Neighborhoods	Sampling Phases														
	Phase 1			Phase 2			Phase 3			Phase 4			Total		
	JUL 28 – AUG 11, Homes Sampled ^{a,b}			SEPT 15 – SEPT 27 Homes Sampled			OCT 27 – NOV 06 Homes Sampled			DEC 01 – DEC 13 Homes Sampled			All Phases Homes Sampled		
	Occ. ^d	Unocc. ^e	Total	Occ.	Unocc.	Total	Occ.	Unocc.	Total	Occ.	Unocc.	Total	Occ.	Unocc.	Total
1	1	0	1	0	1	1	1	1	2	2	1	3	4	3	7
2	2	11	13	1	13	14	1	15	16	2	8	10	6	47	53
3	4	4	8	2	4	6	2	6	8	0	7	7	8	21	29
4	1	14	15	2	19	21	3	18	21	3	25	28	9	76	85
5	0	1	1	1	1	2	0	0	0	0	0	0	1	2	3
6	4	28	32	0	32	32	3	38	41	0	29	29	7	127	134
7	1	4	5	1	8	9	0	1	1	0	4	4	2	17	19
8	1	7	8	1	4	5	1	5	6	1	11	12	4	27	31
9	1	6	7	2	10	12	1	12	13	2	7	9	6	35	41
10	1	12	13	2	12	14	3	13	16	5	8	13	11	45	56
11	0	5	5	1	0	1	2	1	3	0	3	3	3	9	12
12	2	13	15	1	5	6	1	6	7	5	15	20	9	39	48
13	4	19	23	1	13	14	3	11	14	3	14	17	11	57	68
Total All Neighborhoods	22	124	146	15	122	137	21	127	148	23	132	155	81	505	596

^aThe term "homes" includes residential and nonresidential properties.

^bHomes sampled include QA replicates and overlaps

^cOcc.--occupied home

^dUnocc.—unoccupied home

Table 6-5 shows the number of homes sampled and the number of times LCICs were detected during each phase and in each EDA neighborhood. Detection limits for chlorotoluene ranged from 0.4 to 4.2 parts per billion (ppb) and averaged 1.0 ppb for the entire study. For chlorobenzene, detection limits ranged from 0.4 to 3.7 ppb and averaged 0.8 ppb. This variation in detection limits is determined by the analytical instrument's performance during the calibration conducted just prior to sampling each home.

Chlorotoluene was the only LCIC detected. It was detected in only one home and only during Phase 2 of the study. This home, located in Neighborhood 6, was an unoccupied, single-story structure with a basement. The general location of the house is shown in Figure 6-5. During Phase 2, the home was sampled twice (sampling times were eight days apart, at 7:00 a.m. and 11:00 a.m.). Chlorotoluene was detected both times.

A room-by-room investigation of the home where chlorotoluene was detected showed no discernible difference in concentrations vertically or horizontally in the air inside individual rooms of the home. The concentration of chlorotoluene varied slightly from room to room on the main floor. Chlorotoluene was not detected in the basement.

During the initial sampling, the levels in three rooms of the six were above the quantitation limit (2.9 ppb), the levels in two rooms were between the quantitation and detection limits (2.9 and 1.0 ppb, respectively), and the level in the room adjacent to the basement entrance was below the detection limit. During the second sampling, the levels in all six of the first floor rooms were between the quantitation and detection limits (1.5 and 0.5 ppb, respectively). The highest concentration of chlorotoluene detected during the two sampling efforts was 3.4 ppb (during initial sampling). This investigation did not detect chlorotoluene in the air in the basement of the home during either sampling effort.

If the Love Canal were the source of the chlorotoluene, the two potential transport paths for this chemical would be either through the ambient air or by subsurface groundwater. LCICs were not detected in ambient air samples taken outside the home before and after sampling the home. This finding suggests that the LCIC concentration detected in the home was not influenced by transport above surface. Because LCICs are

Table 6-5

Sampling Results Summary By EDA Neighborhood And Phase

Neighborhoods	Sampling Phases				Total All Phases
	Phase 1 JUL 28 - AUG 11	Phase 2 SEPT 15 - SEPT 27	Phase 3 OCT 27 - NOV 06	Phase 4 DEC 01 - DEC 13	
	Homes Sampled ^a	Homes Sampled	Homes Sampled	Homes Sampled	Homes Sampled
1	1	1	2	3	7
2	13	14	16	10	53
3	8	6	8	7	29
4	15	21	21	28	85
5	1	2	0	0	3
6	32	32	41	29	134
7	5	9	1	4	19
8	8	5	6	12	31
9	7	12	13	9	41
10	13	14	16	13	56
11	5	1	3	3	12
12	15	6	7	20	48
13	23	14	14	17	68
Total All Neighborhoods	146	137	148	155	586
	0	2 ^b	0	0	2 ^b

^aHomes sampled include replicates and overlaps.^bChlorotoluene was detected in only one home during Phase 2; this home was sampled twice in Phase 2, and chlorotoluene was detected both times. Further sampling of this home was conducted during Phases 3 and 4 of the study; no LCICs were detected during these later phases. Chlorobenzene was not detected in any homes sampled during the study.

heavier than air, the highest concentrations of these compounds resulting from subsurface transport from the Canal would be expected in the basement. However, chlorotoluene was not detected in the basement samples collected, suggesting the LCIC detection was not influenced by subsurface transport mechanisms either.

Therefore, it is more likely that the source of chlorotoluene was located in the home on the main floor. The extensive investigation of the home, which included both a vertical and a perimeter sweep of each room, however, did not identify a specific source of chlorotoluene.

As specified in the proposed habitability criteria (NYSDOH and DHHS/CDC, 1986), retesting of the home was also performed in Phases 3 and 4. No LCICs were detected during the retesting in Phases 3 and 4. Chlorotoluene detection limits during Phase 3 and 4 sampling of the home were 1.4 and 0.8 ppb, respectively. The house, primarily the garage, was being used by personnel working for Love Canal Area Revitalization Agency (LCARA). However, no products or materials used by these workers were identified as potential sources of chlorotoluene.

During Phase 4 of the study, chlorotoluene was detected once in the ambient air at less than the quantitation limit. The level detected was between the detection limit of 0.4 ppb and the quantitation limit of 1.3 ppb. Transient chlorotoluene signals were observed just below the detection limits throughout the day that chlorotoluene was detected in the ambient air. Sampling during that day was conducted primarily west of the Canal, mostly in Neighborhoods 12 and 13. Based on data collected at the Niagara Falls International Airport, winds were from the west at moderate speed (5 to 10 mph) throughout the day. These data suggest that a source of chlorotoluene may exist west of the EDA and that the source of the detected chlorotoluene was not the Love Canal.

Further discussion of the analytical results obtained throughout the air assessment can be found in the final report issued by the U.S. EPA Environmental Response Team (ERT) (U.S. EPA ERT, 1988).

In summary, of the 562 different homes sampled in the EDA, chlorotoluene was detected in only one home, and chlorobenzene was not detected in any home. There is no evidence to indicate that temporal, spatial, or other variables influence air LCIC concentrations

in EDA homes. Because LCICs were detected in only one home, the importance of the effects of these variables on indoor air concentrations of LCICs could not be determined.

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APPENDIX A
ERT QA/QC
EVALUATION REPORT

A-1



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

EDISON, NEW JERSEY 08837

February 22, 1988

MEMORANDUM

SUBJECT: Summary of the TAGA QA/QC Results Compared Against the Data Quality Objectives

FROM: Thomas H. Pritchett, ERT QA/QC Coordinator (Love Canal)
Environmental Response Branch

TO: Doug Garbarini
Love Canal EDA Habitability Study Project Manager
U.S. EPA Region II, ERRD-NYCRA

Objective #1 - TAGA Accuracy

This criteria specified that the magnitude of the error of the TAGA analyses be less than 25%. This objective was met.

The criteria specified that this objective would be measured by the use of Performance Evaluation Analyses. The QAPP originally specified that the 6 Liter Summa canisters furnished by Northrop Services would be the performance evaluation samples used to define the TAGA's accuracy. However, during the first two phases the true concentrations of the canisters were never known precisely enough for these canisters to be used as true performance evaluation samples. Therefore, during the first two phases the accuracy of the instrument was primarily measured using the Scott standard gas cylinders. The analyzed cylinder was never the same cylinder which was used for the applicable calibration. Starting in phase 2 the analyses of the 16 Liter Summa precision canisters were also used to determine the overall accuracy of the instrument. Finally, in phases 3 & 4 the analyses of the 6 Liter Summa canisters were used in conjunction with the other two analyses to confirm the relative accuracy of the instrument.

The relative accuracy as measured by the Scott performance evaluations never exceeded an absolute value of 25% on any day during the four mobilizations. The largest magnitudes of the relative errors measured by this analysis were 23.0% and 23.1% for chlorotoluene and chlorobenzene, respectively. The relative error as measured by the 6 Liter Summa canisters never exceeded an absolute value of 25% for either compound during phases 3 & 4, but on 11/01/87 it did equal 25% for chlorobenzene. However, on that day the magnitudes of the relative error for chlorobenzene as measured by the Scott cylinder analysis and the 16 Liter Summa canister analysis were 16.3% and

17.6%, respectively. The magnitude of the relative error for the compounds as measured by the 16 Liter canister analyses only exceeded the 25% criteria for only one compound (chlorotoluene) on only one day (October 27, 1987) during phases 2 - 4. However, on that day the magnitudes of the relative error for chlorotoluene as measured by the 6 Liter canister analysis and by the Scott cylinder analysis were 8.8% and 8.0%, respectively. Considering the -6% +7% error in the canister certifications analyses for phase 3, these data points indicate that the overall accuracy of the TAGA was still within the required 25% error criteria for that day.

Objective #2 - TAGA Precision

The criteria for this objective was 25%. The day-to-day precision of the TAGA was actually determined from two sets of replicate analyses. First, as per the QAPP, the precision was determined from the daily analyses of the 16 Liter Summa canisters. The maximum relative standard deviations measured in these analyses throughout the study for chlorotoluene and chlorobenzene were 17.9% and 15.6%, respectively. Because of the larger number of analyses for each sample, the relative standard deviations were also calculated for the Scott standard cylinder analyses. The maximum relative standard deviations measured in these analyses for chlorotoluene and chlorobenzene were 5.4% and 5.5% respectively. Both sets of precision data clearly demonstrate that the TAGA analyses met the required precision data quality objective of 25%.

Objective #3 - Detection Limits for the LCICs

The criteria for this objective was 4 ppb for both LCICs. When the detection limits for the LCICs were rounded to the closest whole number, all of the reported detection limits met this criteria. In only one analysis was the reported detection limit was the unrounded value greater than 4.0 (the reported detection limit was 4.2 ppb). However the house involved was reanalyzed during that phase as a within-phase replicate house analysis and was chosen as one of the houses which was analyzed during each of the remaining phases. Therefore, regardless of one's interpretation of the rounding down of a detection limit to meet the criteria, the overall data quality of that residence was not affected since four additional sets of data - all more than meeting this criteria - were obtained for the house, including an additional set during the same phase as the potentially questionable data set.

Therefore, this criteria was met for every house sampled during each phase.

Objective #4 - Allowable Response Factor Decay Between Subsequent Calibrations

The maximum allowable decay in response factors was specified as 15%. However, this criteria only applied to decays in response factors and did not apply to response factor increases. Because of the emphasis on the TAGA's ability to be able to detect infrequent occurrences of trace levels of the target compounds, no corrective action was required or even warranted

when the instrument sensitivity actually increased by more than 15%, which it often did. This criteria had been established as one means to always insure that the TAGA had sufficient sensitivity to meet the detection limit data quality objectives.

The average response factor decay for either target compound only exceeded 15% twelve times during the whole study. In all cases the appropriate corrective action was taken and the sensitivity stabilized. In all cases the response factors which resulted in the excessive decay were still more than sufficient to give the TAGA the required sensitivity - even before the corrective action was taken.

Since the appropriate corrective actions were taken whenever a set of response factors decayed more than 15% and since in all cases the TAGA had sufficient sensitivity even prior to the corrective action was taken, this data quality objective was met.

Objective #5 - Accuracy of the TAGA Calibrations as Measured by the Accuracy of the Dilution Flowrate Measurements

Two different flow measurements were used in calculating the calibration concentrations - the standard gas flowrate (MFC) and the ambient air dilutant flowrate (SAF). In both cases the accuracy of these measurements had to be less than or equal to 10% to meet this data quality objective criteria. These accuracies were determined on a weekly basis using a Gilian Primary Standard Gas Calibrator for the MFC and a rotameter with a NBS traceable calibration for the SAF. Four different points were checked for each device even though only two of the SAF measurements fell within the typical range used by the TAGA. In all of calibration checks no measurement had an error greater than or equal to 10%. The largest relative error of the SAF and MFC measurements found in the ranges used by the TAGA was equal to 9%.

Therefore, this data quality objective was met.

Objective # 6 - Loss of LCICs in Sampling Lines

This data quality objective was actually measured as percent transport efficiencies (i.e., 100% - % sample loss). The data quality objective criteria of less than or equal to 15% sample loss thus translated into a percent transport efficiency of criteria of greater than or equal to 85%. The percent transport efficiencies were determined twice daily throughout the sampling program. The measured transport efficiencies for chlorotoluene and chlorobenzene ranged from 88.6% to 122% and from 90.7% to 120%, respectively. During phase 1 heated transfer lines were used to draw air samples into the TAGA while in phases 2 - 4 unheated lines were used. The lowest temperature, as measured by the TAGA's thermometer, at which either type of transfer line was used was 31° F. The transport efficiencies measured at this temperature were 99.2% and 99.5% for chlorotoluene and chlorobenzene, respectively.

This criteria was met throughout all phases - even though unheated sampling lines were used in phases 2 - 4.

Objective 7 - 100% of the Residences Sampled

Since the actual selection of residences to be sampled was controlled by the on-site CH2M Hill task leader, the final determination of whether this objective was met is not within the scope of this report. However, it is within the scope of this report to comment on the status of the data for the residences sampled. All data packages for the house sampled did pass all the data review and data validation criteria. Thus, acceptable data packages were generated for all of the residences sampled by the TAGA.

Objective #8 - Documentation Complete and Consistent

This objective has been sufficiently met to allow all of data to be used. The consistency and completeness of the data packages were checked by two separate steps each performed by a different group under the direction of the ERT QA/QC Coordinator. First, all packages underwent a data review by the TAGA Data Review group who had primary responsibility for completing all incomplete data packages and for insuring that each package was internally consistent. After the data review was completed, the data package was turned over to the Data Validation group who double-checked the package for data entry errors, for completeness, and for internal consistency. All of the data packages generated during this study have passed these two stages and all significant inconsistencies and omissions in the packages have been corrected. If any such errors still do exist, they will be too minor to adversely affect the quality of the data packages.

cc: B. Coakley, U.S. EPA-ERT
G. Helms, CH2M Hill
D. Mickunas, Roy F. Weston, Inc. (REAC)

APPENDIX B
EMSL--RTP
SUMMARY AUDIT REPORT



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27711

MEMORANDUM

DATE: January 25, 1988

SUBJ: Report Summarizing the 1987 Audits on the
Love Canal Habitability Study

FROM: William J. Mitchell, Ph.D. *Bill Mitchell*
Chief, PEB/QAD/EMSL (MD-77B)

TO: Doug Garbarini
EPA, Region II

As you requested, Northrop Services prepared the attached report which summarizes the results from the performance and systems audits they conducted in 1987 on the Love Canal Habitability Study. The report is very complimentary towards the project. I concur with their opinion. You and the other project personnel are to be congratulated for your achievements regarding the Love Canal Study.

If you have questions, please call me at FTS 629-2769 or 919/541-2769.

Attachment

cc: G. Akland
T. Hartlage

Summary Audit Report
Love Canal Habitability Study
(Phase 1 - 4)

July - December 1987

Prepared by:

B.J. Carpenter and Kenneth J. Caviston
Northrop Services - Environmental Sciences
Research Triangle Park, NC

for

EPA/EMSL/QAD
Research Triangle Park, NC

INTRODUCTION

Northrop Services -Environmental Sciences was directed by the Quality Assurance Division, EMSL,RTP,NC to provide QA support to EPA's Love Canal Habitability Study at Niagara Falls, NY. This support was provided under Contract 68-02-4444.

NSI audit teams visited the Emergency Declaration Area at the Love Canal during each of the four mobilizations conducted between July and December 1987. Systems and Performance audits were conducted by NSI. The Systems audits assessed overall project management, documentation, safety, and conformance of these systems to the Quality Assurance Project Plan (QAPP). The performance audits assessed the conformance to the eight Data Quality Objectives contained in Table 4 - 1 of the QAPP. The results are summarized below.

SYSTEMS AUDITS

The system implemented for the Love Canal study can actually be subdivided into four units: management, sampling, analysis, data handling. The original system was designed using "best guess" estimates and was modified as individuals gained experience with the project.

This project could have become a logistical nightmare. However, the management staff minimized the impact of any problems by attempting to anticipate them and when problems occurred took timely corrective action.

The auditors found that any deviations from the QAPP were well documented in the Task Managers notebooks. Some of these changes (e.g. personnel changes) did not always make their way into a revised QAPP or Standard Operating Procedure. However, these were minor points and had little bearing on data quality.

The sampling phase of this project introduced the auditors to a new set of faces during each mobilization. Each individual we observed was well qualified to perform his assigned duties. We did notice during mobilizations 3 and 4 that the sampling team had little knowledge of the history of the project. Overall, the individuals knew their assignment and performed it professionally.

The Standard Operating and Reporting Procedure was strictly adhered to by the TAGA operators. Any deviations were thoroughly documented and, in the opinion of the audit team, these changes improved the data quality.

The data review and validation phase of the project was designed with redundancy in mind. Each step of the data collecting process had a duplicate step as a check corresponding to it. The final step (data validation) was an independent and detailed examination of all documentation and data. These steps were being closely adhered to by the personnel handling the data.

In our opinion, the project was conducted in accordance with the approved QAPP.

PERFORMANCE AUDIT

The QAPP lists eight Quality Objectives for the Love Canal Habitability Study. The NSI audit team feels that all of the data quality objectives were usually met. There were some cases of non-attainment but these were documented and corrective action was immediately implemented.

Objective 1 - Accuracy. ($\leq 25\%$)

The accuracy of the TAGA was determined using blind canisters prepared by the EPA-RTP Organic Standards Laboratory. The criteria to be met was $< 25\%$. The first two canisters analyzed were outside this limit. When investigation showed that this was a problem in the TAGA delivery system, action was taken that corrected the problem. After this analyses were well within the 25% limit.

Objective 2 - Precision. ($\leq 25\%$)

This was determined by periodic analysis of the same cylinder/canister. Our review of the data during each audit showed that this criteria was met consistently.

Objective 3 - Detection Limits. (≤ 4 PPB)

Our review of the data indicated that the detection limit was less than 4 PPB for each residence.

Objective 4 - Ion Signal Decay. ($\leq 15\%$)

The audit team noted that corrective action was taken when the decay was greater than 15%. This was a well documented and rare occurrence.

Objective 5 - Accuracy of TAGA Calibration. ($\leq 10\%$)

The audit team used a laminar flow element to check the sample air flow and the mass flow controller. The flows in the usable ranges of both systems agreed with the NBS traceable LFE within the 10% specified in the QAPP.

One of the flows used to check the mass flowmeter was 10 ml/sec. During mobilizations 3 & 4 the LFE and mass flow controller differed by +10.3% and + 10.6%. Although technically a violation of the data criteria, it will have no affect on data quality since this flow is outside the range used in the Love Canal Study.

Objective 6 - Loss of LCIC in Sampling Lines. ($\leq 15\%$)

The sampling efficiency was checked each sampling day. The audit team observed this procedure during each mobilization and checked notebooks for previous results. The loss of LCIC was always less than the 15% criteria specified in the QAPP.

Objective 7 - Residential Structures Sampled. (100%)

"Percentage of EDA for which permission to gain entry was granted and for which the structure was determined safe to enter."

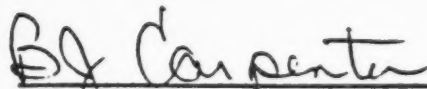
The audit team spent a great deal of time comparing sampling schedules, maps, notebooks and the actual EDA. For the most part, the objective was met, however, we did observe two residences which could not be sampled because the probe would not reach the house.

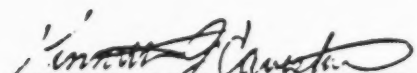
Objective 8 - Documentation Complete and Consistent for Sampled Residence.
(100%)

We observed the sampling documentation being collected on several occasions and checked the completed packages for several residences. The documentation checked was complete and agreed with what we had visually observed.

In our opinion, all of the data objectives were met during the study. The variations noted were minor, documented, immediately corrected and had no effect on the quality of the data.

Submitted by:


B.J. Carpenter


K.J. Caviston

APPENDIX C
ERT/TAT
DATA VALIDATION REPORT



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

EDISON, NEW JERSEY 08837

February 22, 1988

MEMORANDUM

SUBJECT: Summary of the Data Validation of the TAGA Data

FROM: Thomas H. Pritchett, ERT QA/QC Coordinator (Love Canal)
Environmental Response Branch

TO: Doug Garbarini
Love Canal EDA Habitability Study Project Manager
U.S. EPA Region II, ERRD-NYCRA

All TAGA data packages underwent a thorough data validation by the TAT team using the checklists summarized in Tables 7-1 and 7-2 of Appendix A of the QAPP. Appendix A contained the Summary of the TAGA Standard Operating and Reporting Procedures (SORP) for the Love Canal Full-Scale Air Sampling Study. Each day's data package was validated separately. A daily Data Validation Logsheet was prepared for each package in order to summarize the QA/QC data as it pertained to the data quality objectives, any major deviations from the QAPP, and any major errors which might reflect upon the data quality of either the daily or a housespecific data package. Figure 1 contains an example of one the daily Data Validation Logsheets.

In some instances the problems noted in the logsheet could only be addressed by a memorandum to the Love Canal files which modified the TAGA procedures specified in the QAPP (e.g., changing the identification criteria for compounds present above the quantitation limit), which clarified an ambiguity or typographical error in the QAPP (e.g., reversing the required cryoshell temperatures in the Instrument Startup Checklist for cryoshells #2 and #3) or which interpreted the effect the deviation had on the quality of a given daily or a house-specific data package (e.g., not having the required 30 sequences of measurements collected on an obvious "non-detect" data point). Those cases, which resulted in an ERT QA/QC Coordinator memorandum to the Love Canal files, were indicated by the Coordinator's initials in block C of the Comments section of the logsheet.

All minor data transcription errors were indicated by Post-It notes attached to the appropriate sheets in the data package. An example of one of these notes can be observed in Figure 2. These notes were used to indicate such errors as a failure to initial an entry change, an obvious transcription error in a logsheet (i.e., one of three replicate entries did not agree for the same data), or a failure to enter a piece of manual entry data in one of the logsheets. Since all manual entry data were entered on two to three

different forms (as specified in Table 6.3.2 of the SORP) such errors were relatively easy to catch and correct.

After completing the data validation, the TAT team then returned the data package to the ERT QA/QC coordinator who reviewed the Data Validation Logsheet in order to determine the appropriate corrective action for the noted problems and QAPP deviations in the package. In addition, the ERT QA/QC coordinator reviewed the errors flagged with the Post-It notes. After these two reviews, the data package and the completed Data Validation Logsheet was given back to the TAGA data review team for the appropriate corrective actions. Once the appropriate corrections were made, this corrected package became the official data package for that day to be later included in the TAGA group's final report to the ERT.

All of the daily data packages have undergone this process and the required corrections and/or corrective actions have been made. No house-specific data packages were pulled from the daily packages because of the data validation. However, when houses were selected for replicate sampling, the houses with the explanatory action by the ERT QA/QC Coordinator in a previous house-specific package were always given first priority for resampling.

Enclosures

cc: B. Coakley, U.S. EPA-ERT
G. Helms, CH2M Hill
D. Mickunas, Roy F. Weston, Inc. (REAC)

FIGURE 1. Typical Data Validation Logsheet (page 1 of 2)

DATA VALIDATION COMMENTS LOG

Date of sampling: 12/11/87
 Date data package received: 12/11/87
 Date D.V. Logsheet completed: 12/11/87
 Date data package finalized:

To minimize errors related to instrument response, check the following:

ACTION	FREQUENCY	CRITERIA	COMMENTS
SAF Calibration	1) upon arrival at LC 2) weekly thereafter 3) before demobilizing	<10% Error	Days since last check <u>4</u>
MFC Calibration	1) upon arrival at LC 2) weekly thereafter 3) before demobilizing	<10% Error	Days since last check <u>4</u>
% Transport Efficiency	1) start of day 2) end of day	> or = 85% OK	1) CTCL-102.1%, (SEN-102.2%) 2) CTCL-95.1%, (SEN-96.5%)
Verification of Calculated Quantitation Limits	1) end of day	1) within 2% of calculated Quant. Limits 2) <25% Error	1) OK 2) OK CTCL-89%, (SEN-137%)
Accuracy and Precision using Cylinder/Canister of known conc.	1) cylinder -- start of day 2) canister -- every other day, at end of day	<25% Error need 9EE IC (acc. 2)	1) CTCL-9.9%, (SEN-3.3%)
Accuracy using PE Cylinder/Canister	1) one PE cylinder/canister a day, at start of day	<25% Error OK	CTCL-13.1%, (SEN-9.2%)
Response Factor Decays	1) every calibration	all average RF Decays < or = 15%	OK - One calibration had high RF Decays and was revalidated



FIGURE 1 (cont.) Typical Data Validation Logsheet (page 2 of 2)

KEY:

- A = Comment does not affect data quality.
 B = Comment requires Data Review action.
 C = Comment requires explanatory action by ERT QA/QC Coordinator.
 D = Comment requires house data package withdrawal
 (house to be scheduled for resampling).

COMMENTS:

1) A _____ B IFD C _____ D _____
 Five house packages have sampling leg times on house or more earlier than
 the time on the TARA leg and several other houses had ~~times~~ sampling leg
 times made on house early.

2) A IFD B _____ C _____ D _____
 57 Mason Cr - Site LC4191 - Anomalous segment at end of file has only
 10 samples but this is OK since it was followed by a full interval segment
 in a new file.

3) A _____ B _____ C _____ D _____

4) A _____ B _____ C _____ D _____

5) A _____ B _____ C _____ D _____

6) A _____ B _____ C _____ D _____

FIGURE 2. Example of a Manual Data Entry Error Flagged by a Post-It Note During the Data Validation

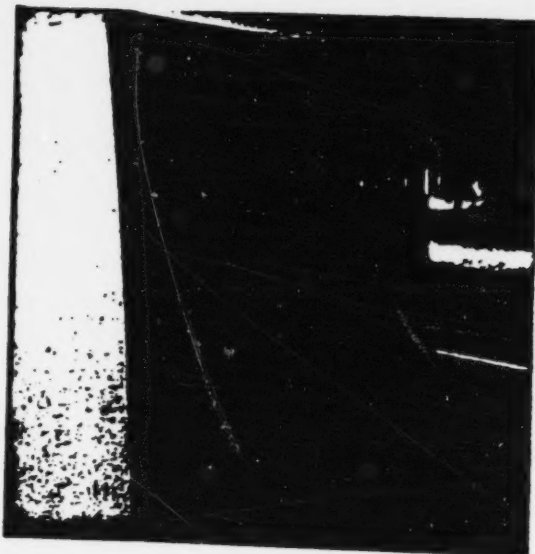
INVESTIGATIVE SAMPLING LOG

Page of

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best available copy.



TAGA File: LC 2039

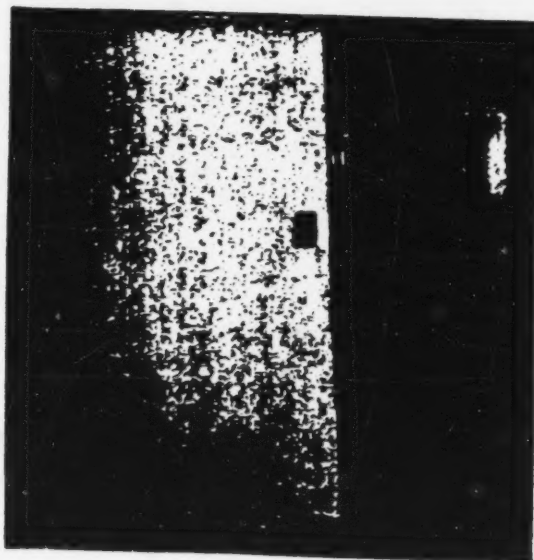


BRI SOUTH WALL

Description

BRI - South wall
- Cedar lined closet
- air freshener on
shelf.

Page ? of ?



BRI NORTH WALL

Description

- Eastern wall of BRI
and entrance

Love Canal Emergency Declaration
Area Habitability Study. Volume 2
Air Assessment: Indicator Chemicals

CH2M Hill Southeast, Inc., Reston, VA

Prepared for

Environmental Protection Agency, New York

Feb 88